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ABSTRACT

The Wisconsin Foundation for Vocational, Technical, and Adult Education is currently involved in the development, implementation, and distribution of a sophisticated interactive computer and video learning system. Designed to offer trainees an open entry and open exit opportunity to pace themselves through a comprehensive competency-based, individualized program in basic electronics, the available courseware covers alternating current (AC) and direct current (DC) circuits. Currently under production is courseware dealing with semiconductor devices and digital techniques. The following topics are covered in the course on DC circuits: matter and charges; current flow and circuits; electromotive force; batteries and voltage drops; resistance; Ohm's law and power; magnetism; current and ammeters; voltmeters and ohmmeters; series, parallel, and voltage divider circuits; circuit analysis; Thevenin's and Norton's theorems; inductance and capacitance; and capacitive circuits. Addressed in the course on AC circuits are the sine wave and AC values, AC measurements, resistive circuits and capacitors, capacitive circuits, math applications in AC circuits, inductive circuits, transformer theory and applications, series resonance, and parallel resonance and filters. A number of interactive learning stations produced by the Wisconsin Foundation and the College of San Mateo are operational in major industries in California, where over 250 trainees are using the system. Furthermore, Wisconsin recently installed its first four stations near Milwaukee, where Comprehensive Employment and Training Act-eligible students will receive electronics training. (MN)

# INTERACTIVE VIDEO-BASED INDUSTRIAL TRAINING IN BASIC ELECTRONICS

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## ABSTRACT

The Wisconsin Foundation for Vocational, Technical and Adult Education, Inc. is involved in the development, implementation and distribution of a sophisticated interactive computer/video learning system. The system offers trainees an open entry/exit opportunity to pace themselves through a comprehensive competency-based, individualized program in basic electronics. At this time, available courseware covers AC/DC Circuits. Courseware in Semiconductor Devices and Digital Techniques is currently in production. Major components of the system include: microcomputer, 2 disc drives, VCR, monitor, Whitney Interface Card, various electronic testing equipment and other laboratory equipment. A number of interactive learning stations have been installed and are operational in major industries in California, where over 250 trainees are benefitting from the system. Wisconsin recently installed its first four stations in Waukesha County outside Milwaukee, where CETA eligible students will receive electronics training.

## BACKGROUND

The Wisconsin Foundation for Vocational, Technical and Adult Education, Inc. was established to receive gifts, grants bequests and other things of value for the benefit of vocational education in Wisconsin. During the past several years, the major focus of the Foundation has been on the production and acquisition of video-based instructional materials with the objectives of: 1) better serving distance learners through broadcast and cable television offerings; and 2) better serving the training needs of business and industry by offering on-site video courses through a local vocational-technical institute. The Foundation's greatest success has been with the use of a linear video series called "Basic Electricity and AC-DC Circuits." The states of Wisconsin, Florida and Oregon and the Province of British Columbia have adopted the series for systemwide use. Also, numerous television stations, colleges and industries across the nation are using the AC-DC series successfully.

A little over one year ago, the Foundation began a rather fruitful relationship with the College of San Mateo, which is ideally situated in California to serve the training needs of Silicon Valley. As part of Governor Brown's initiative to halt the slump in American science and technology and to end the shortage of skilled technicians, the College of San Mateo received substantial funding through the California Worksite Education and Training Act (CWETA) to develop a training approach for the immediate area.

Staff members in the Electronics Department at San Mateo decided they had a golden opportunity to create almost everything a good teaching system should have. They wanted to use video, but insisted that the trainee's experience include interactivity and active participation. In addition, their tall order included requirements for a system that would be: competency-based, individualized, self-paced, open entry/open exit and computer-managed. I believe San Mateo has made a very noteworthy attempt to achieve these goals.

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San Mateo's efforts to develop an interactive computer/video learning system in electronics began with the adaptation of the theory tapes from the Foundation's AC-DC video series. San Mateo then produced additional video and programmed an Apple II microcomputer to provide the necessary interactivity they were seeking. At this point, a comprehensive course in basic electronics and AC-DC circuits has been completed. In production, are courses in Digital Techniques and Semiconductor Devices, which should be completed during this year. Also planned for the interactive system is a course in Microprocessors.

Partially as a result of the Foundation's initial contribution of software to the San Mateo project, the Foundation will become the national distributor for all the courseware mentioned above.

## HOW THE SYSTEM WORKS INSTRUCTIONALLY

All the required software, lab equipment, computer, video player and monitor are arranged in the learning station, creating a pleasant work environment. Also provided is a telephone, which allows the trainee direct access to an instructor for purposes of technical troubleshooting and consultation on content difficulties.

Trainees are guided through the course by following the structured study guide. The course is divided into modules. For each module there is a separate box of diskettes and students are referred to the correct corresponding videotapes. Each module can include up to five different types of activities, but may include only some of them, depending on content requirements. The five activities are:

### Active Homework Review

No videotape is used for this activity. The trainee simply loads the review diskette and answers questions on the previous homework assignment. This is done mainly to refresh the trainee's memory and to indicate whether he/she is, in fact, ready to begin the module.

### Pre/Post Test

No videotape is used for this activity. Trainees may feel that their previous knowledge and experience make it unnecessary for them to proceed through a particular module. They are free to test out of the module by passing the Pre Test. If trainees do work through the module, they must pass the Post Test before moving on to the next module. Pre/Post Tests include about 10-12 questions, which are randomly generated from a bank of approximately 125 questions.

### Theory Lessons

Almost all of the modules include at least one theory lesson, providing the required understanding to complete the laboratory applications. Trainees load the theory videotape and the corresponding diskette and proceed to work through the lesson. The Apple controls the VCR, showing only 2-3 minute segments of video, which are ended either by computer-generated directives or by a question(s). Trainees cannot advance to the next segment of video before correctly answering the question(s) at the end of the previous segment. Wrong answers automatically activate the system to provide a video review segment.

Right answers are acknowledged by a friendly computer-generated pat-on-the-back.

All of the interactive videotapes can be paused by pressing the space bar. Pressing the "H" key stops the videotape and provides the following choices: 1. Rewind 20 seconds; 2. Fast forward to the next stop; 3. Menu; 4. Quit now; 5. Continue.

Skill Modules

The skill modules are usually brief interactive video lessons, which sharpen specific skills needed to complete laboratory applications. For example, one of the skill modules is on the basic operation of an oscilloscope. Trainees are guided through the procedures for setting up and operating an oscilloscope by means of an interactive hands-on experience.

Lab Jobs

The interactive lab jobs are perhaps the most powerful learning tool in the system. Lab experiments are carefully explained on video and trainees are given specific instructions for setting up equipment, making correct connections and setting appropriate dials. Trainees feed readings and measurements into the Apple at relevant intervals, so that the computer can check progress throughout the experiment. Once again, the computer will not allow the trainee to advance to the next phase of the experiment until all previous procedures have been correctly executed.

The System Manager

The "Sysman" diskette is loaded in the second disk drive at all times. It's purpose is to keep accurate records of the trainee's performance. Trainees enter their Identification Number before beginning any activity. The computer checks the I.D. to establish whether or not the trainee has permission to work on a particular activity. "Sysman" records the time and date the trainee began and ended an activity and also keeps accurate test scores. At any point, the course manager (instructor) can get a printout to review the trainee's progress and performance.

## AVAILABLE COURSEWARE

As previously mentioned, basic electronics courses in DC and AC circuits have already been completed for use in the interactive system. The configuration of available diskettes and videotapes for these courses follows hereunder:

DC Circuits

- 18 Theory videotapes
- 6 Skill module videotapes
- 14 Lab Job videotapes
- 18 Theory diskettes
- 6 Skill Module diskettes
- 14 Lab Job diskettes
- 14 Homework Review diskettes
- 14 Pre/Post Test diskettes
- 1 "Sysman" System Manager diskette
- 2 Miscellaneous diskettes

AC Circuits

- 13 Theory videotapes
- 2 Skill Module videotapes
- 10 Lab Job videotapes
- 13 Theory diskettes
- 2 Skill Module diskettes
- 10 Lab Job diskettes
- 13 Homework Review diskettes
- 13 Pre/Post Test diskettes
- 1 "Sysman" System Manager diskette

The DC Circuits course is divided into 14 modules and the AC Circuits course has 13 modules. The titles of the modules are as follows:

DC Circuits

1. Matter and Charges
2. Current Flow and Circuits
3. Electromotive Force
4. Batteries and Voltage Drops
5. Resistance
6. Ohm's Law and Power
7. Magnetism
8. Current and Ammeters
9. Voltmeters and Ohmmeters
10. Series, Parallel and Voltage Divider Circuits
11. Circuit Analysis
12. Thevenin's and Norton's Theorems
13. Inductance and Capacitance
14. Capacitive Circuits

AC Circuits

1. Introduction to Alternating Current
2. The Sine Wave and AC Values
3. AC Measurements
4. Resistive Circuits and Introduction to Capacitors
5. Capacitive Circuits
6. Math Applications in AC Circuits
7. Inductive Circuits
8. RL Circuits
9. Transformer Theory
10. Transformer Applications
11. RLC Circuits
12. Series Resonance
13. Parallel Resonance and Filters

## THE SYSTEM'S HARDWARE

The following is a list of the hardware needed to run the interactive system and the equipment needed for the trainee's hands-on laboratory activities. It should be noted that the videotapes can be used in any format as long as the VCR is equipped with the necessary remote plug.

Hardware

1. Apple II - Plus 48K
2. Two disk drives
3. Any reasonable monitor
4. Sony Betamax SLO 323
5. Whitney Interface Card
6. Mountain Computer Clock Card

Laboratory Equipment

1. Frequency Counter
2. FET Multimeter
3. Digital Multimeter
4. Tri-Power Supply
5. Oscilloscope
6. Signal Generator
7. LCR Bridge
8. Calculator
9. Headphones
10. Electronic Doorbell
11. Darkroom Timer
12. Soldering Iron
13. Assorted Parts Kits and Test Leads

## OPERATIONAL INTERACTIVE TRAINING SITES

California

Under the project funded through the California Worksite Education and Training Act, the College of San Mateo has attempted to achieve three major objectives: 1) to address the shortage of skilled technicians in the electronics industry; 2) to upgrade entry-level employees to fill more sophisticated technical positions; and 3) to provide college credit courses through on-the-job training in a realistic work environment.

To accomplish these objectives, CSM cooperated with private industry and "moved" the College to the worksite. Approximately 25 interactive learning stations have been installed in prominent electronics companies, including AMI, Ampex, Apple, Farinon, Hewlett-Packard, Litton, Savin, Siltec and Watkins-Johnson. To date, the project is serving over 250 employed workers, who are preparing for advancement into higher level technical jobs in the participating companies. The trainees and company officers have expressed overall satisfaction with the experiment and most are anxiously awaiting the follow-up courses in digital and semiconductors.

Wisconsin

Wisconsin is currently in the process of setting up a demonstration site for the interactive system. Under a grant through the Comprehensive Employment and Training Act, four interactive learning stations are being installed in an

outreach center of the Waukesha County Technical Institute near Milwaukee. These stations will be used primarily to train CETA eligible students, who are unemployed and seeking retraining for technical occupations. To date, 20 students have signed up for the training, but school officials are expecting more as word spreads. One unique advantage of the Waukesha project is that it provides the rest of the vocational-technical education system with the opportunity to watch the interactive training project in action. Already, two additional Wisconsin vocational schools are preparing to train employees on-site at local industries using the interactive system.

## CONCLUSION

We have gone beyond comparing the beauty of one piece of technology with another. We have gone beyond merely demonstrating the capabilities of various interactive systems. We have been discussing here a fully-developed, operational interactive computer/video learning system, which now actually exists for the teaching of electronics. The system uses high quality video materials produced by the Wisconsin Foundation for Vocational, Technical and Adult Education, Inc. and the College of San Mateo. The interactive microcomputer programming was produced by the College of San Mateo and the entire software package is currently distributed by the Foundation.

This interactive system is noteworthy for the serious effort that was made to design a genuine competency-based, individualized, self-paced, open entry/open exit training package. The major advantage of the system is that it can be used time and cost effectively for on-site training in an occupational area that is clearly feeling the strains of a labor shortage. Moreover, the system has been tested in Silicon Valley and, from all reports, it really works.

Perhaps, the most exciting aspect of this interactive system is its potential to act as a catalyst in bringing industry and education together to achieve common goals. The staggering developments in alternative learning technology demand that educators "get into the act." In the process of doing so, they are finding efficient new ways to serve serious industrial training needs.

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